



Modifications physiopathologiques et particularités de prise en charge ventilatoire des sujets obèses

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Introduction

- Selon l'Organisation mondiale de la santé (OMS), l'**obésité** est considérée comme **la première épidémie non infectieuse** de l'histoire.
- La **mortalité** qui **lui est imputée** peut aller jusqu'à **22 %** de réduction de l'espérance de vie chez les hommes
- Pathologie fréquente

Dans les unités de Réanimation:

❖ **un tiers (30%)** des patients ont un IMC ≥ 30 kg/m² et,

❖ **7 %** des patients ont un IMC ≥ 40 kg/m²

- Mood disorders
- Social stigma



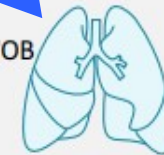
- Chronic inflammation
- Altered immunity
- Increased infection risk



- Chronic cardiovascular disease
- Increased cardiac output
- Standard monitoring less reliable
- Risk of insufficient fluid resuscitation



- Increased VO_2 , CO_2 production and WOB
- Reduced compliance and FRC
- OSAHS / Difficult airway



- Non-alcoholic fatty liver disease
- Altered drug metabolism
- Nutrition-induced dyslipidemia



- Chronic kidney disease
- Increased risk of AKI



- Altered pharmacokinetics
- Adapted drug dosing



- Increased fat mass (energy source)
- Hidden sarcopenia
- Hyperglycemia /Dyslipidemia
- Caloric and protein target based on adjusted BW



Modifications physiologiques liées à l'obésité

- ✓ **Fonction cardiovasculaire**
 - ✓ Système vasculaire
 - ✓ Fonction cardiaque
- ✓ **Distribution et métabolisme des drogues**
- ✓ **Fonction respiratoire**
 - ✓ Poumons
 - ✓ Centre de la respiration

Obésité et Problèmes respiratoires



Adaptation cardio-pulmonaire

Mais...

Physiologie pulmonaire du sujet obèse

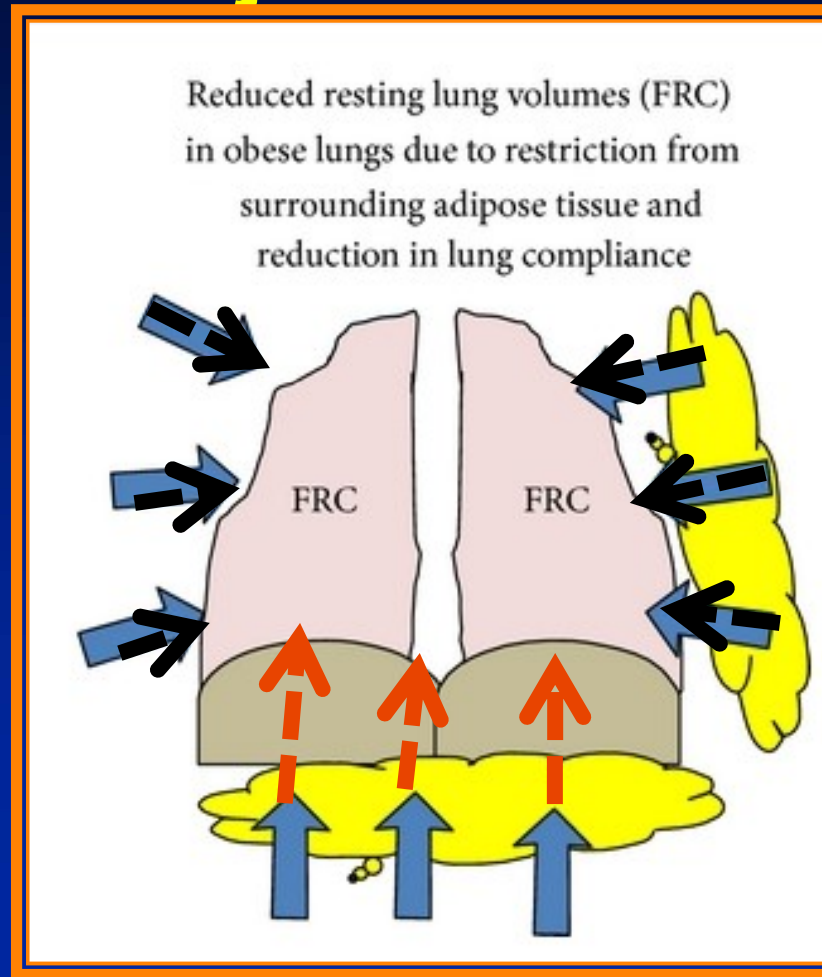


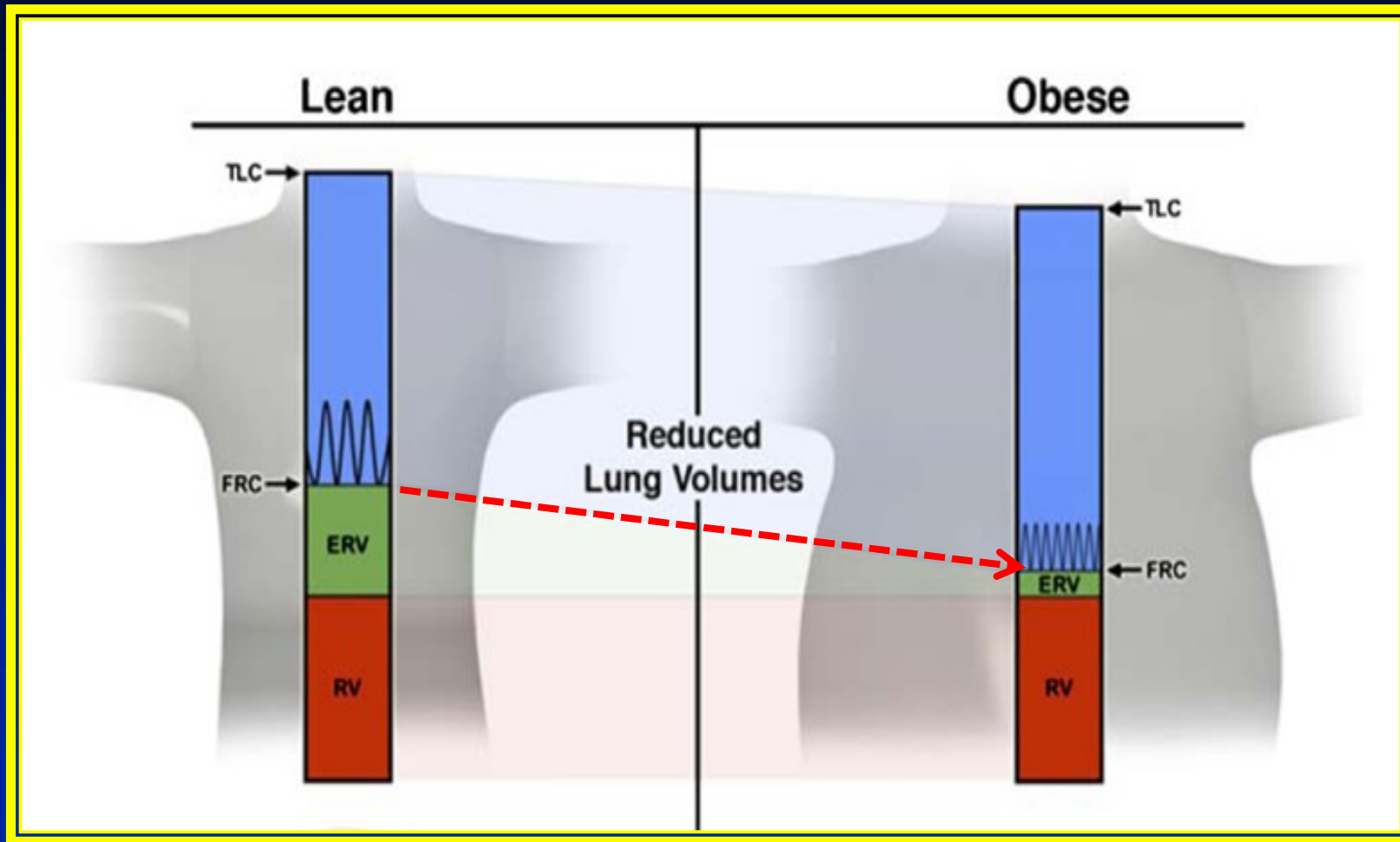
Upper airway collapse



Physiologie pulmonaire du sujet obèse

↙ Compliance
du système
respiratoire





DA Beutler et al; AJRCCM 2006

A

Obese
Sex: female
Age: 53 years
Height: 155 cm
Weight: 125 kg
BMI=52 kg/m²



B



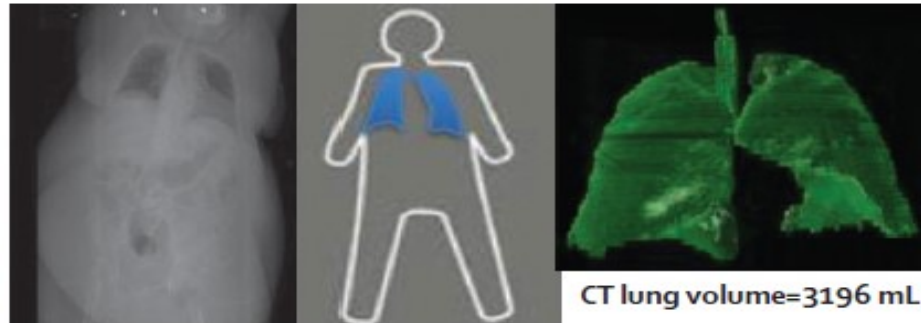
CT lung volume=3138 mL

C

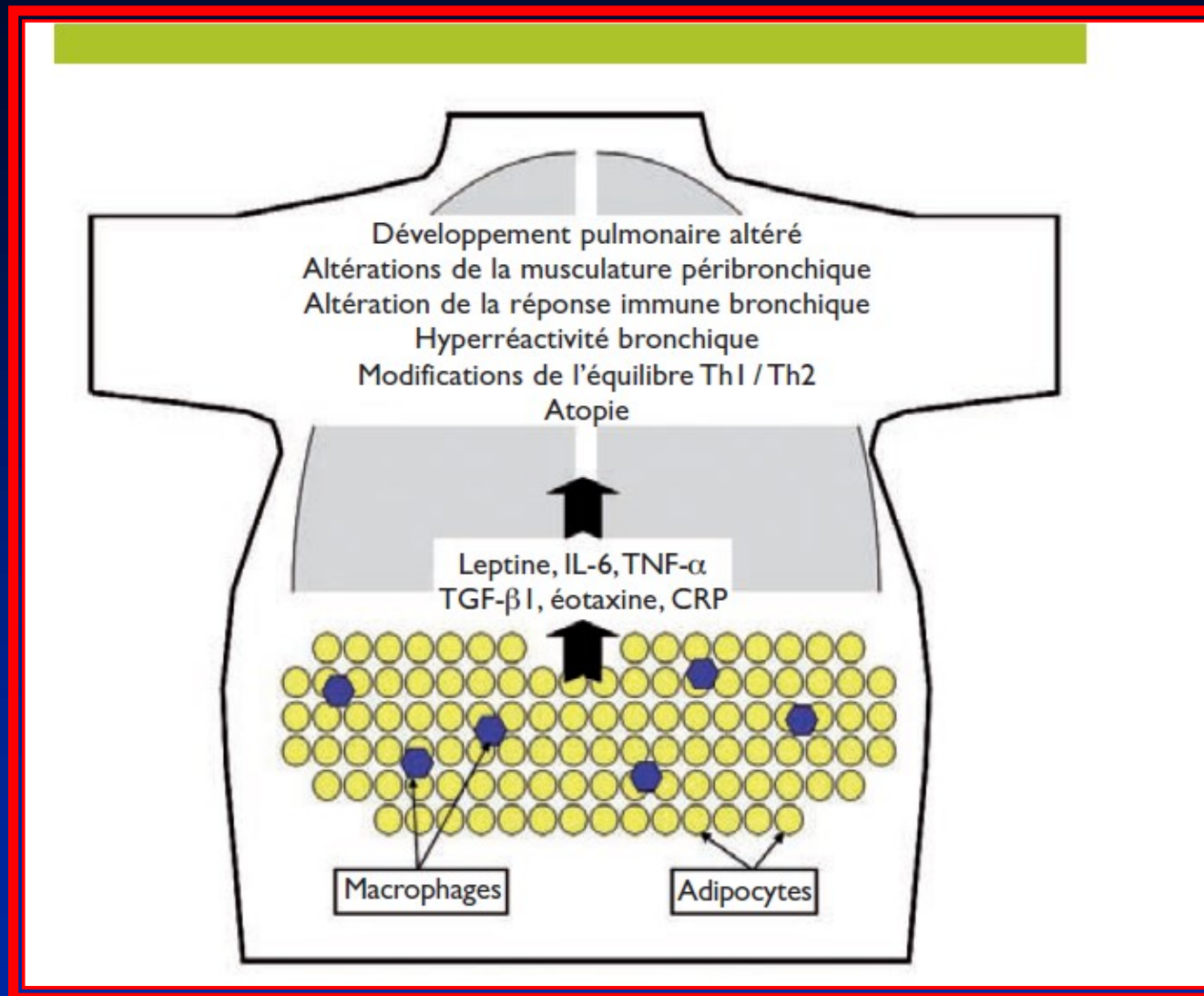
Non-obese
Sex: female
Age: 65 years
Height: 164 cm
Weight: 57 kg
BMI=21 kg/m²



D



CT lung volume=3196 mL

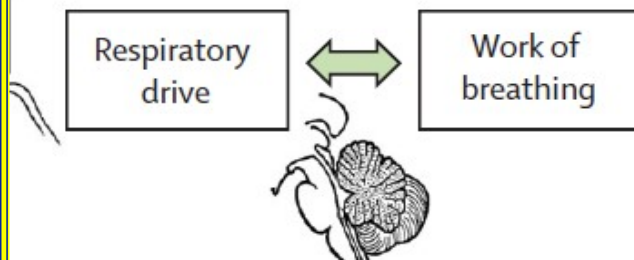


Adipose tissue in the abdomen
and surrounding chest walls

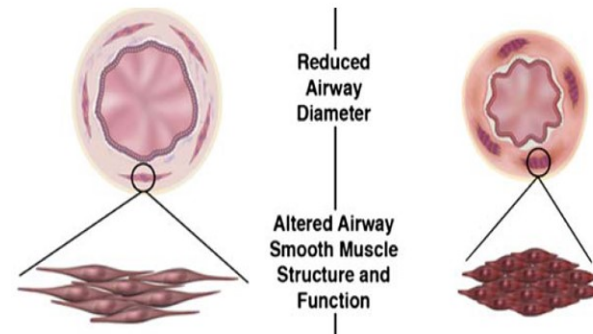


Ventilation-perfusion mismatching
Low PaO_2

Obesity hypoventilation syndrome

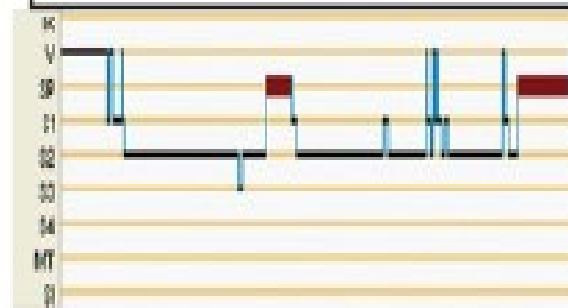


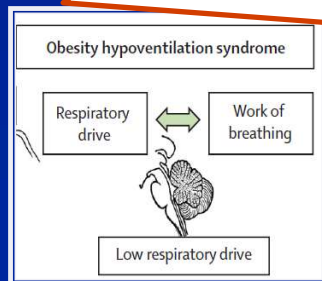
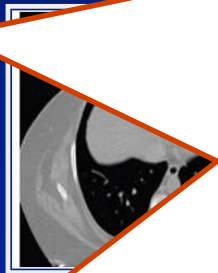
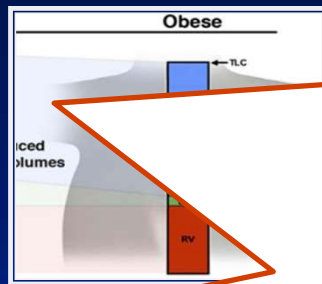
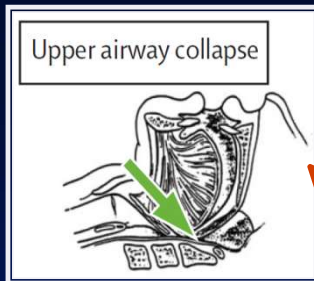
Altération de la commande
respiratoire « drive »



Hyperréactivité bronchique

REM sleep





Aggravation par la VM

Une altération, apparemment réversible,
de la commande ou drive respiratoire

S

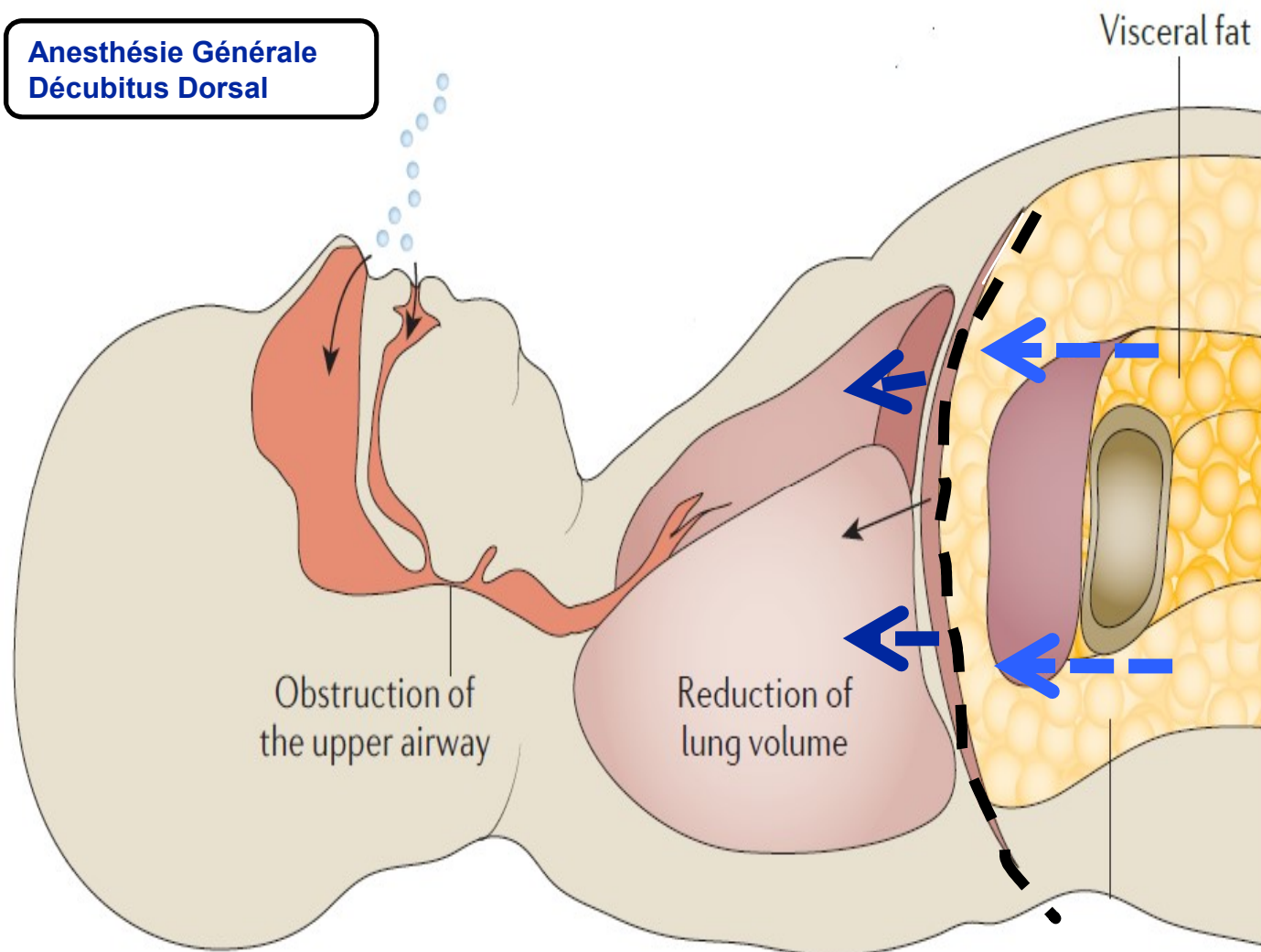
gmatique

monaires

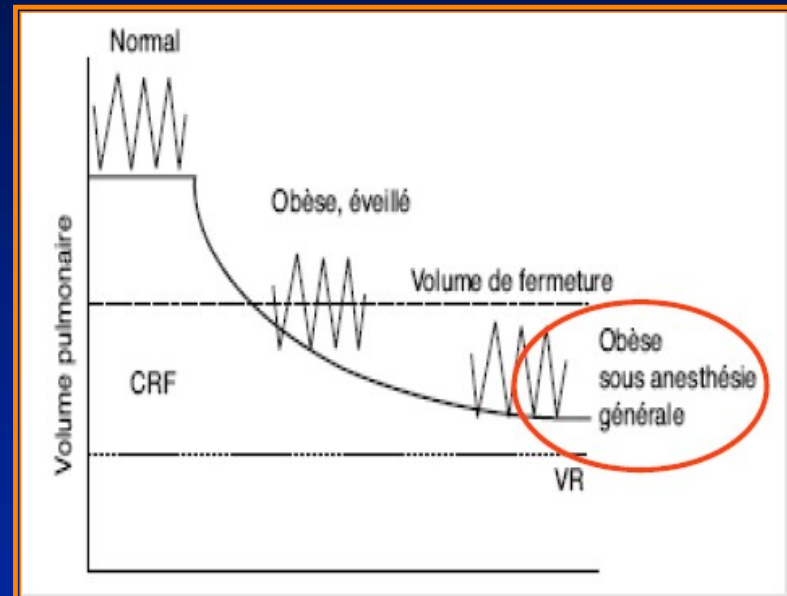
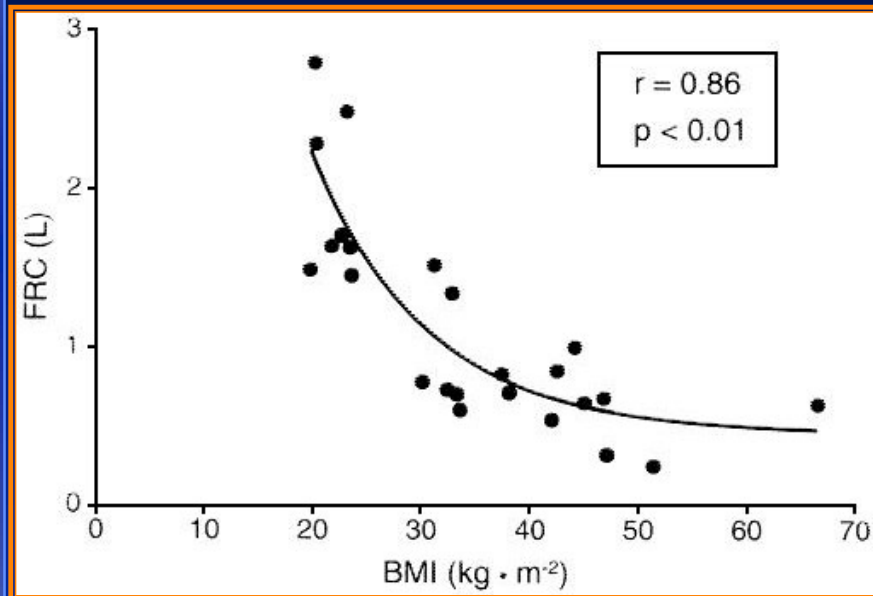
Shunt...o-PEEP



Anesthésie Générale
Décubitus Dorsal



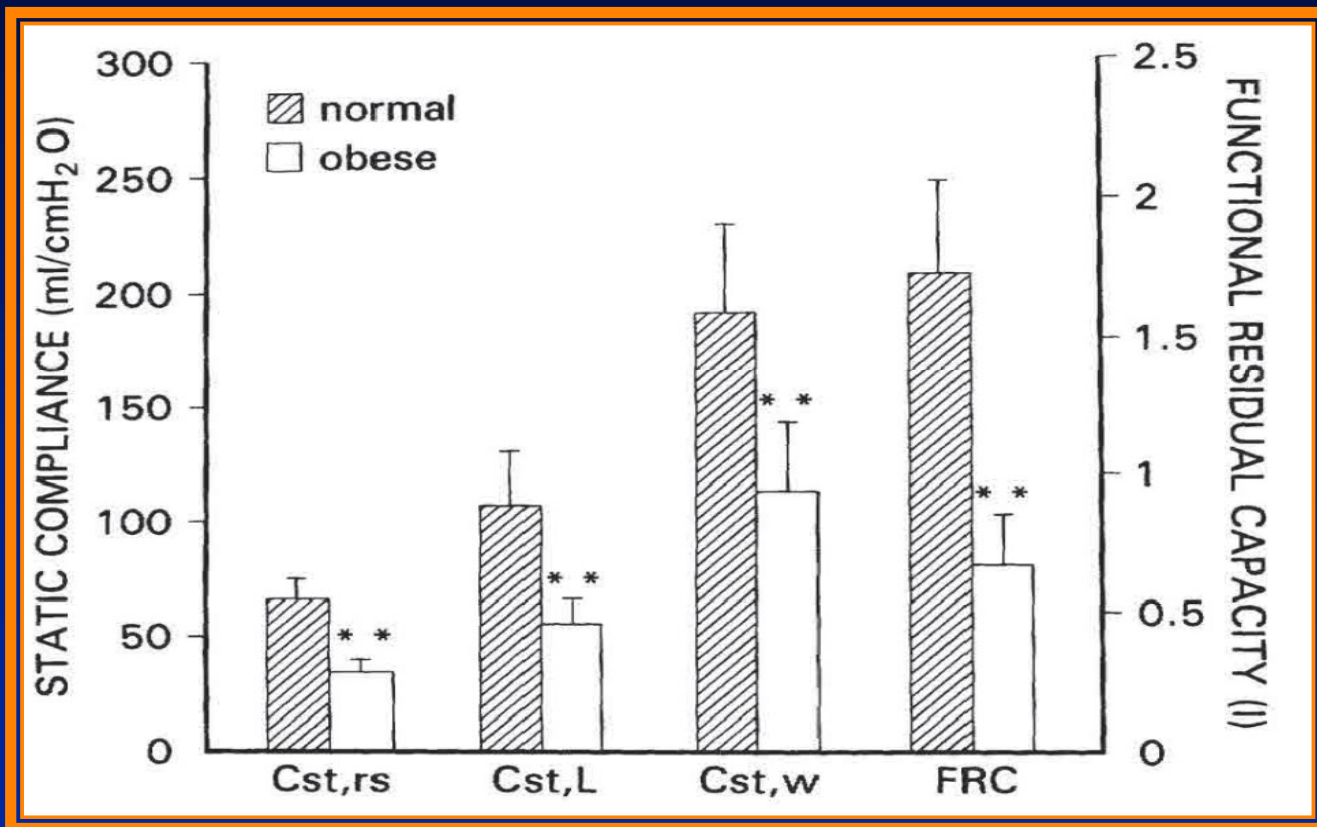
Prone positioning improves pulmonary function in obese patients during general anesthesia.



Sous AG: CRF < volumes de fermeture = **risque d'atélectasies**

P Pelosi **Anesth Analg.** 1996 Sep;83(3):578-83.

**Total respiratory system, lung, and chest wall mechanics
in sedated-paralyzed postoperative morbidly obese
patients.**



Chest. 1996 Jan;109(1):144-51.

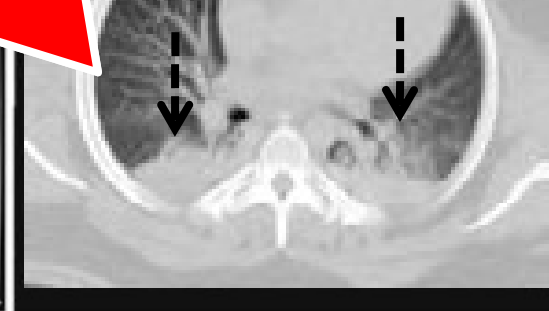
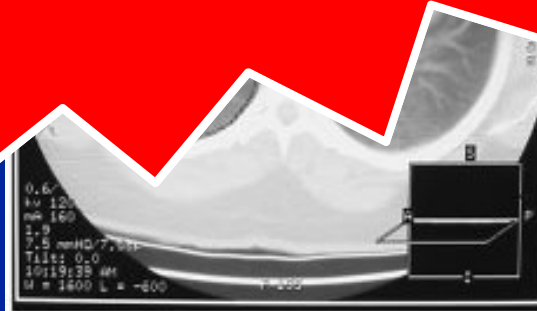
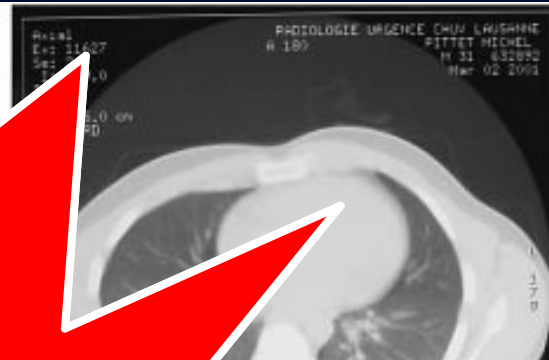
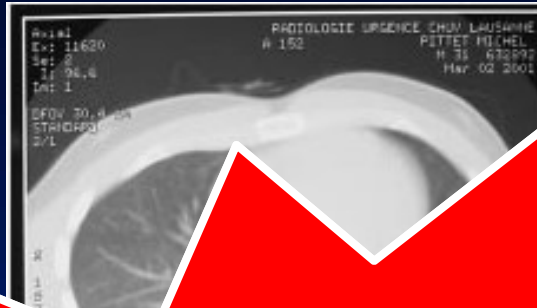
Avant VM

Après VM

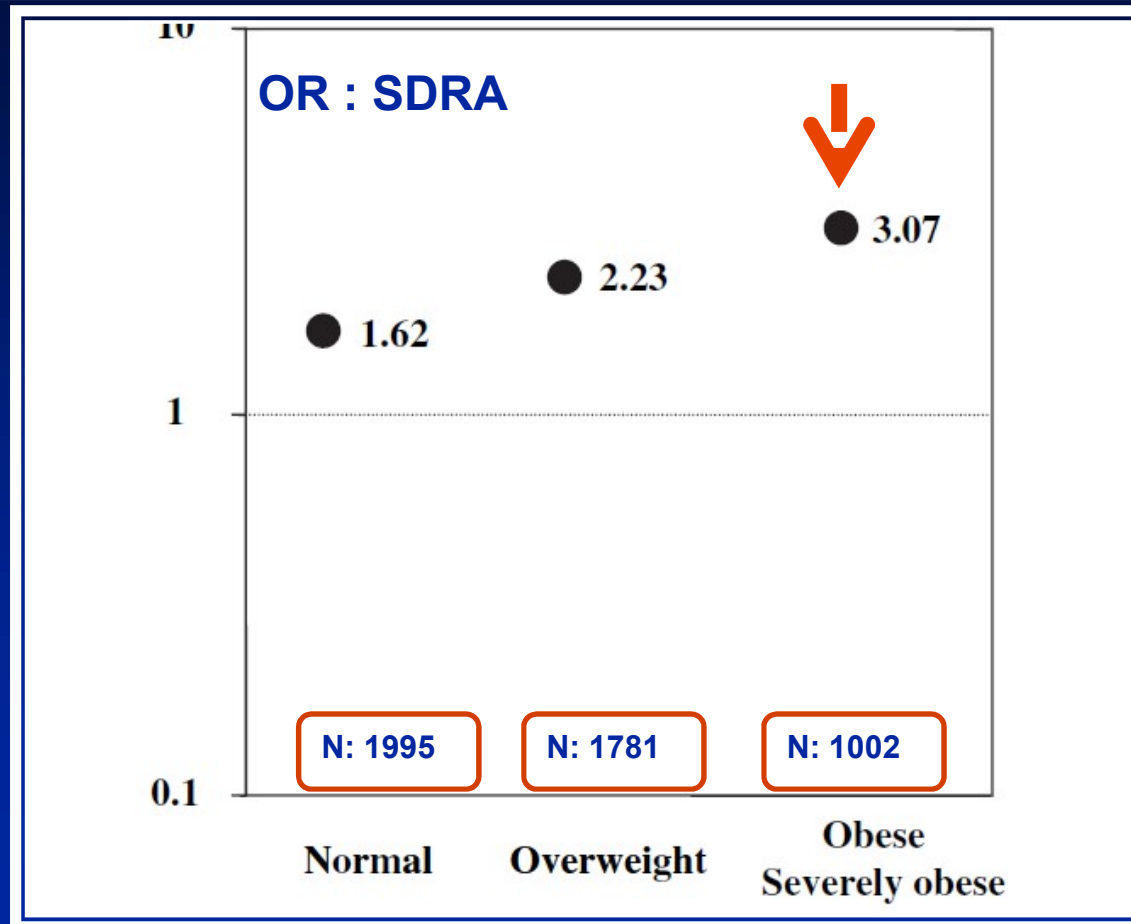
Normal

Ober

**Complications
Respiratoires
Majeures chez
l'obèse ventilé**



Influence of body mass index on outcome of the mechanically ventilated patients



Anzueto A et al. Thorax. 2011 Jan;66(1):66-73

Patient Obèse

Spécificité Ventilatoire

La Ventilation Mécanique

- **Buts:**



Particularités physiopathologiques du patient obèse

Intubation

- Obésité : Temps de désaturation réduit +++

**Une Pré-oxygénation
adéquate est
nécessaire**

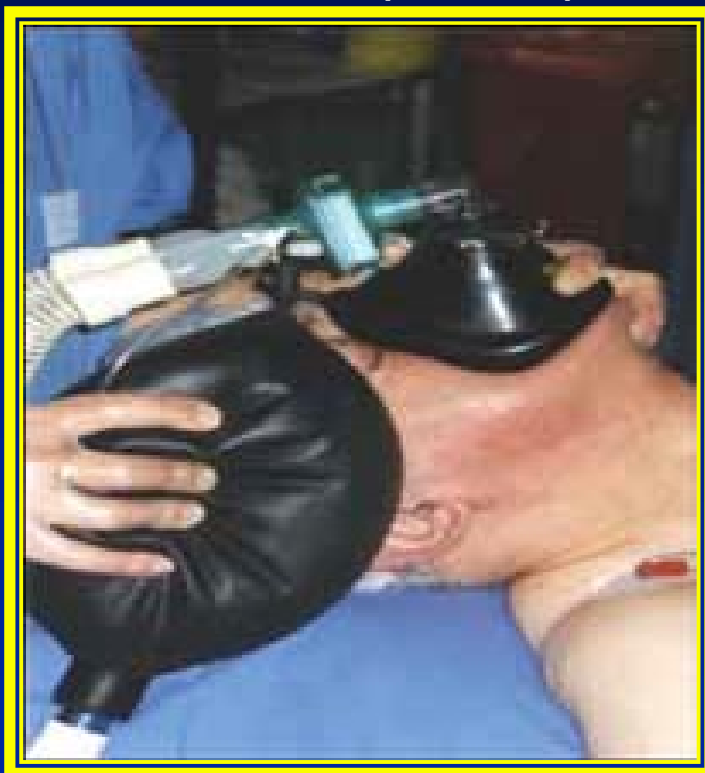
Pre-oxygenation in the obese patient: effects of position on tolerance to apnoea



British Journal of Anaesthesia 95 (5): 706–9 (2005)
doi:10.1093/bja/aei231 Advance Access publication September 2, 2005

Noninvasive Ventilation and Alveolar Recruitment Maneuver Improve Respiratory Function during and after Intubation of Morbidly Obese Patients

Standard (balloon)

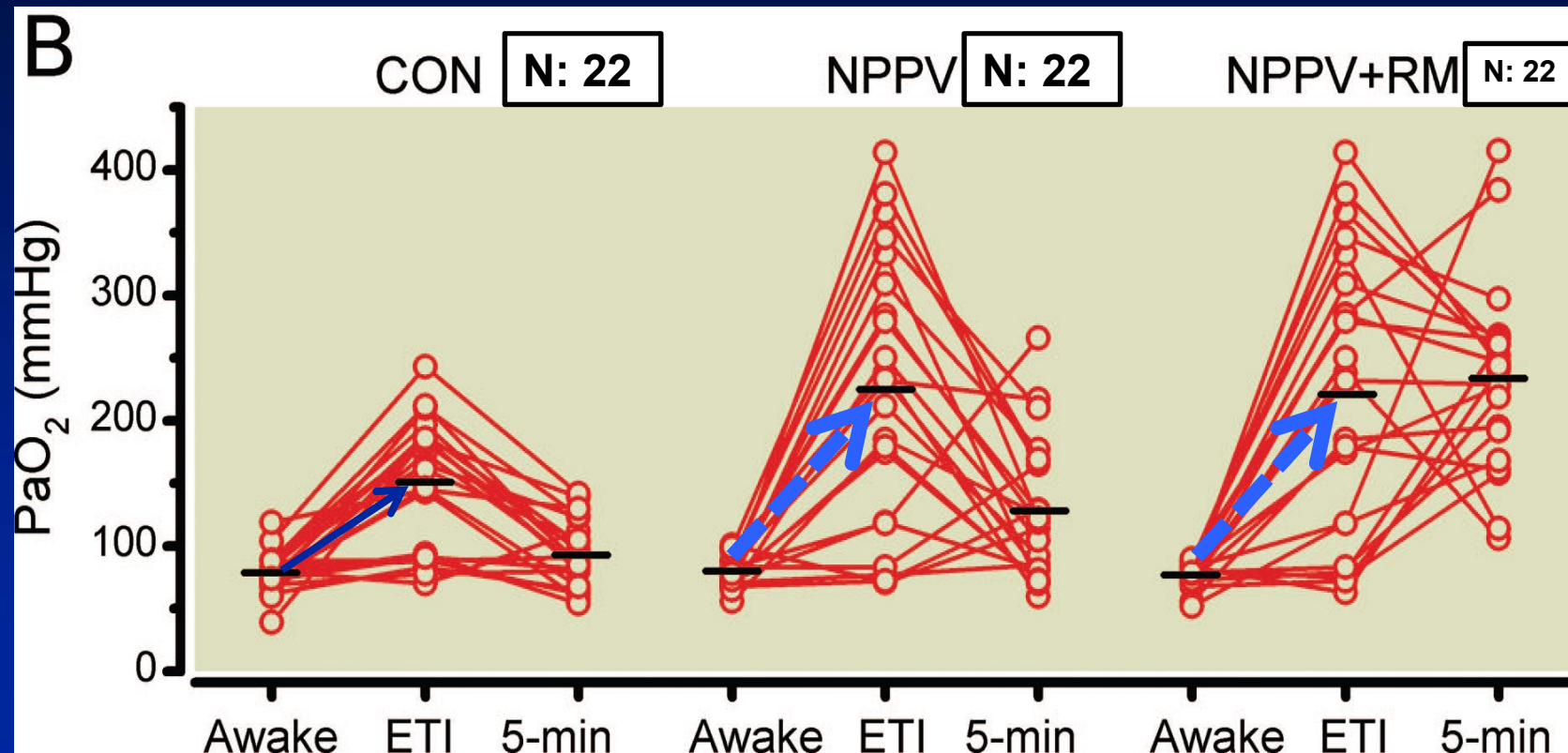


CPAP-preOxy
NIV (PSV+PEEP)-preOxy



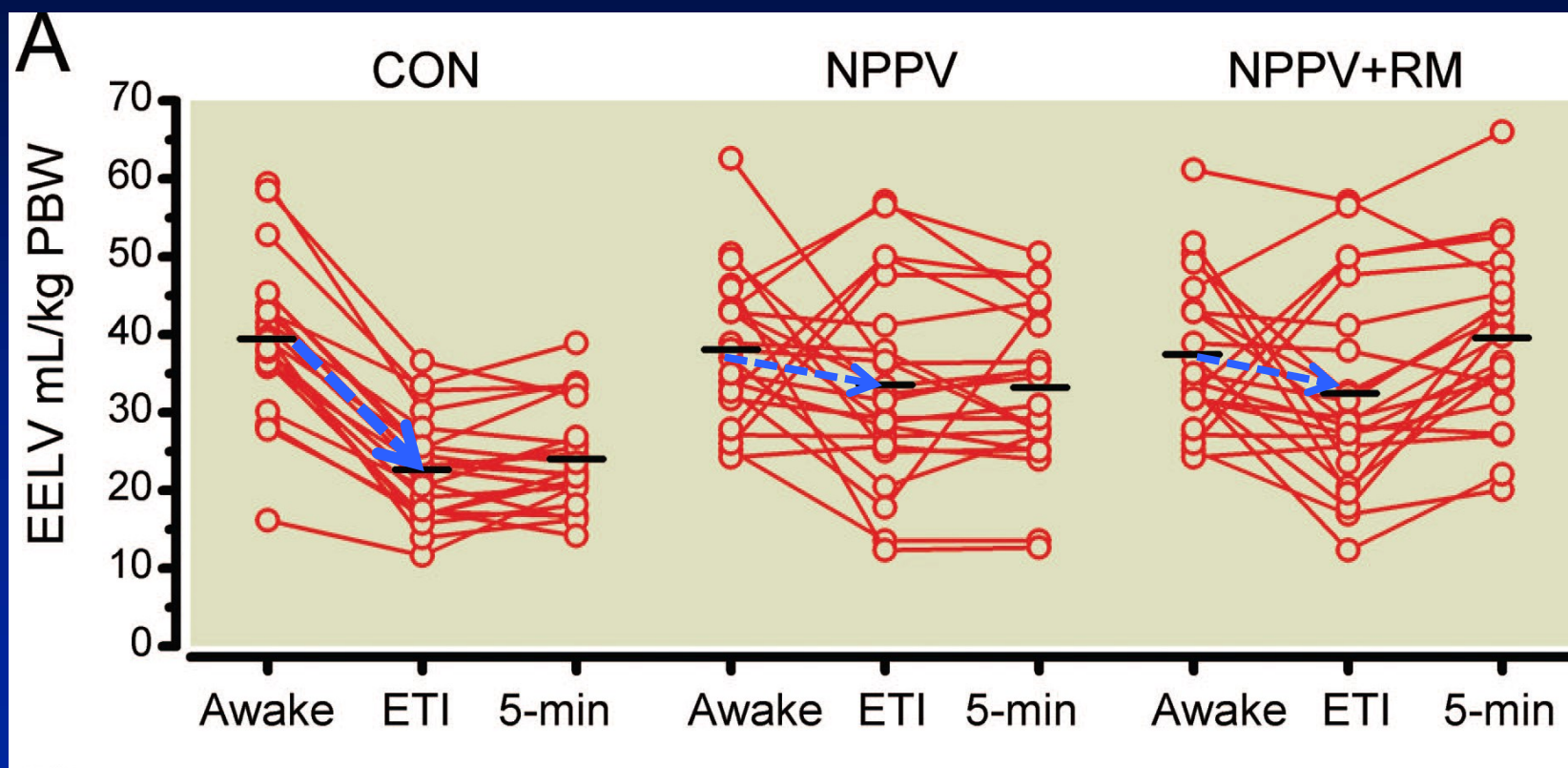
Anesthesiology 2011 114: 1354-1363

Noninvasive Ventilation and Alveolar Recruitment Maneuver Improve Respiratory Function during and after Intubation of Morbidly Obese Patients



Anesthesiology 2011 114: 1354-1363

Noninvasive Ventilation and Alveolar Recruitment Maneuver Improve Respiratory Function during and after Intubation of Morbidly Obese Patients



Anesthesiology 2011 114: 1354-1363

RESPIRATION AND THE AIRWAY

Difficult intubation in obese patients: incidence, risk factors, and complications in the operating theatre and in intensive care units

A. De Jong¹, N. Molinari², Y. Pouzeratte¹, D. Verzilli¹, G. Chanques¹, B. Jung^{1,3}, E. Futier¹, P.-F. Perrigault⁶, P. Colson⁴, X. Capdevila⁵ and S. Jaber^{1,3*}

- **Multicentre prospective observational cohort study in ICU and OT in obese (BMI $\geq$ 30 kg m²) patients**

- **In cohorts of 1400 and 11 035 consecutive patients intubated in ICU and in the OT, 282 (20%) and 2103 (19%) were obese**

British Journal of Anaesthesia **114** (2): 297–306 (2015)

Advance Access publication 27 November 2014 · doi:10.1093/bja/aeu373

Service Réanimation

Bloc Opératoire

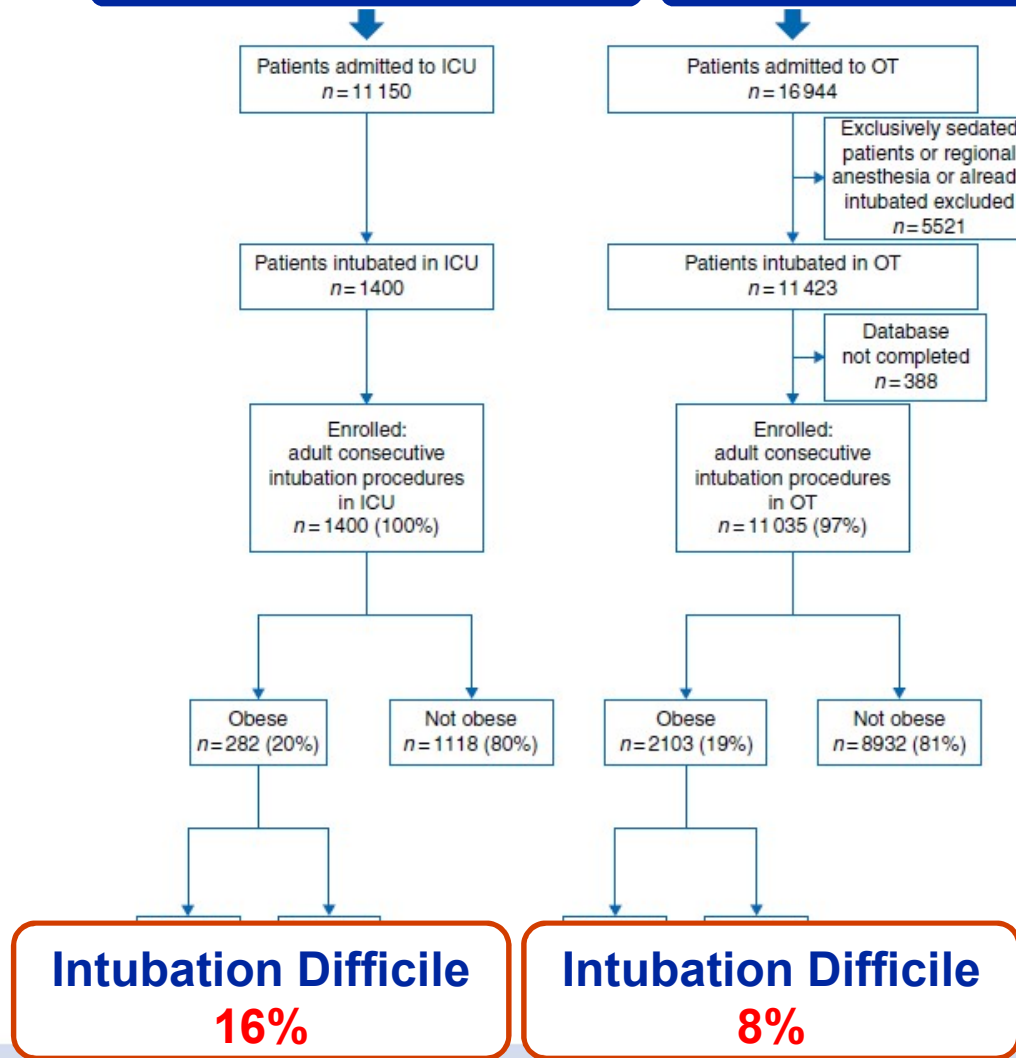


Fig 1 Flow chart of the study.

Intubation de l'obèse

1. Considérer comme Toujours Difficile +++
2. Préparation Adéquate: Intubation vidéo-guidée +++



Stratégie Ventilatoire

Chez le patient obèse il ya:

1. Baisse de 35% de la compliance du système respiratoire
2. Modification des volumes pulmonaires (CRF) avec effet shunt
3. L'anesthésie et la VM majorent ces phénomènes avec diminution de plus de 50% de la CRF (<20% chez le patient non obèse)

Réglages du ventilateur

Volume Contrôlé ou Pression Contrôlée ?

???

British
doi:10

RE

Ver
a q

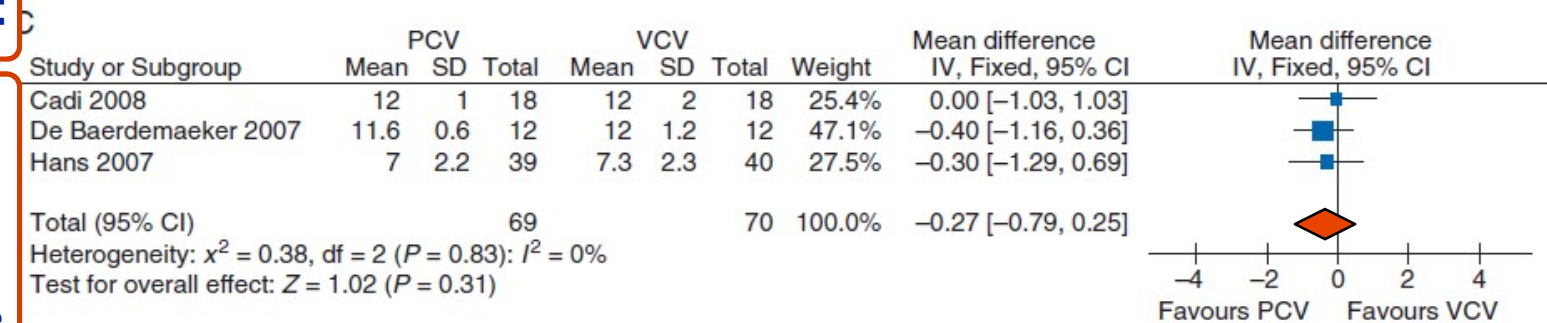
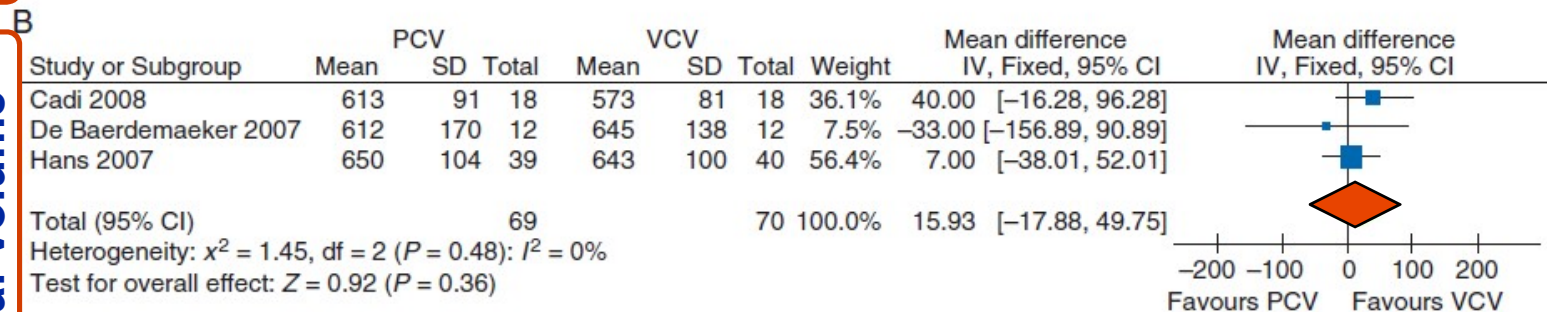
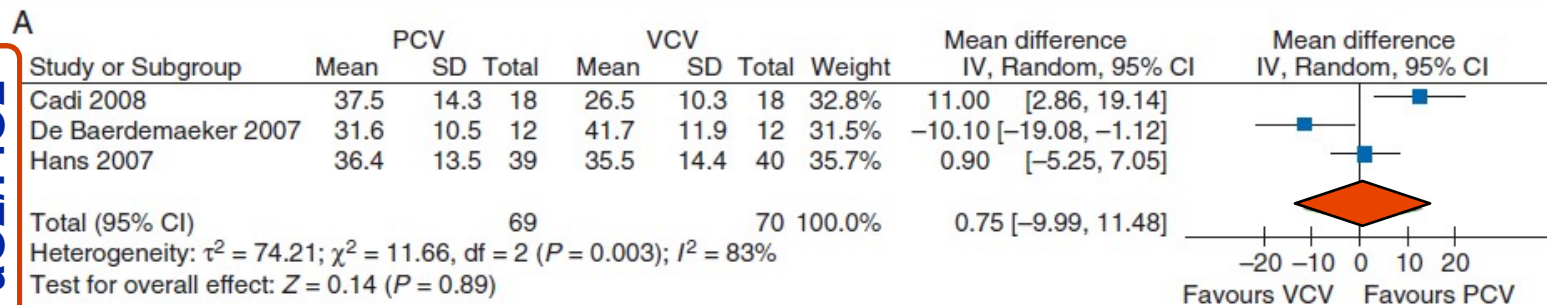
BJA

gery:

PaO₂/FiO₂

Tidal Volume

Airways Pressure



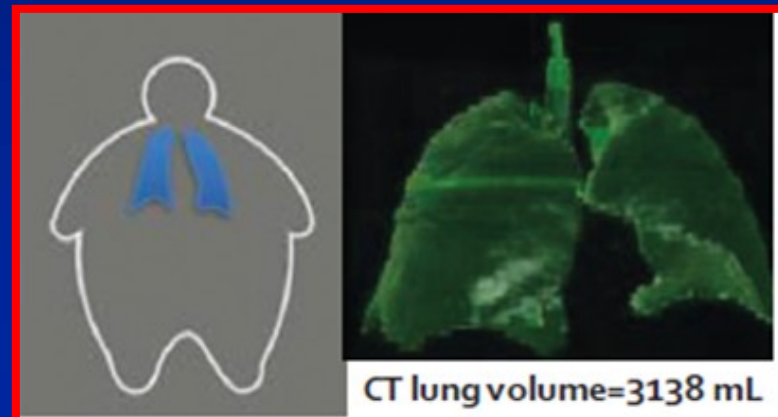
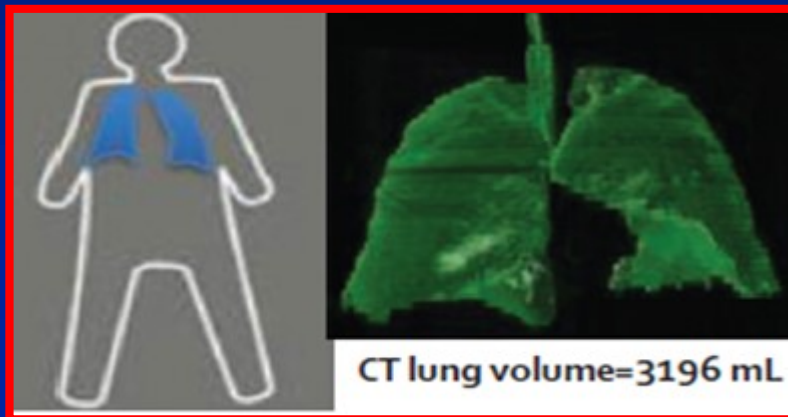
3 VCV vs PCV. (A) Impact on intraoperative PaO₂/FiO₂ ratio (kPa). (b) Impact on intraoperative tidal volume (ml). (c) Impact on intraoperative mean airway pressure (cm H₂O).

Règles de la Ventilation: Ventilation Protectrice

- Volume courant: 6-8 ml/kg du poids idéal:

Poids idéal **chez l'homme** : taille (cm) – 100

Poids idéal **chez la femme** : taille (cm) – 110



Règles de la Ventilation: Ventilation Protectrice

- Maintenir une pression de Plateau ≤ 30 cmH₂O
- FR: 15-21 cycles/min
- Utiliser une PEP de 8-10 Cm H₂O +++
- Utiliser une PEP de: 2/3 Auto PEP
- Manœuvres de recrutement +++

Anesthesiology
1999; 91:1221-31
© 1999 American Society of Anesthesiologists, Inc.
Lippincott Williams & Wilkins, Inc.

Positive End-expiratory Pressure Improves Respiratory Function in Obese but not in Normal Subjects during Anesthesia and Paralysis

Paolo Pelosi, M.D.,* Irene Ravagnan, M.D.,† Gabriella Giurati, M.D.,† Mauro Panigada, M.D.,‡
Nicola Bottino, M.D.,‡ Stefano Tredici, M.D.,‡ Giuditta Eccher, M.D.,‡ Luciano Gattinoni, M.D.§

- **Application d'une PEP:** très bénéfique chez le patient obèse dès l'intubation
- Permet d'éviter le collapsus alvéolaire
- Recrutement alvéolaire
- Peu de retentissement hémodynamique
- Niveau de PEP: Pas de niveau optimal!

Application d'une PEP

NORMAL

N: 9

OBESSE

N: 9

Oxygenation increased with
PEEP in obese patients (**FiO2 50%**):

110 ± 30 to 130 ± 28 mmHg
(P < 0.01)

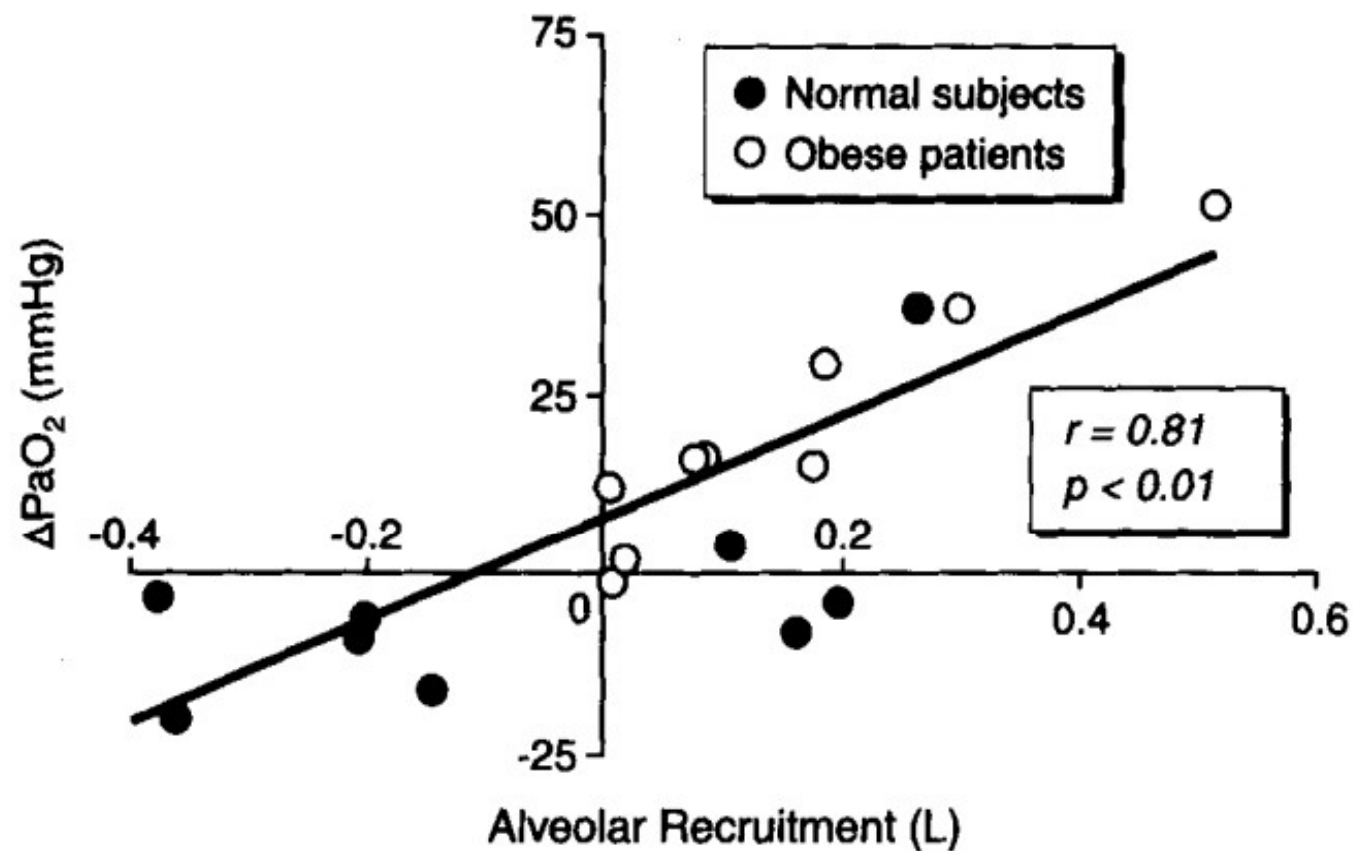


Fig. 2. Relationship between arterial oxygen tension changes and alveolar recruitment with positive end-expiratory pressure in normal subjects (*black circles*) and obese patients (*white circles*).

Manœuvre de recrutement alvéolaire

Recruitment Maneuvers and Positive End-Expiratory Pressure Titration in Morbidly Obese ICU Patients

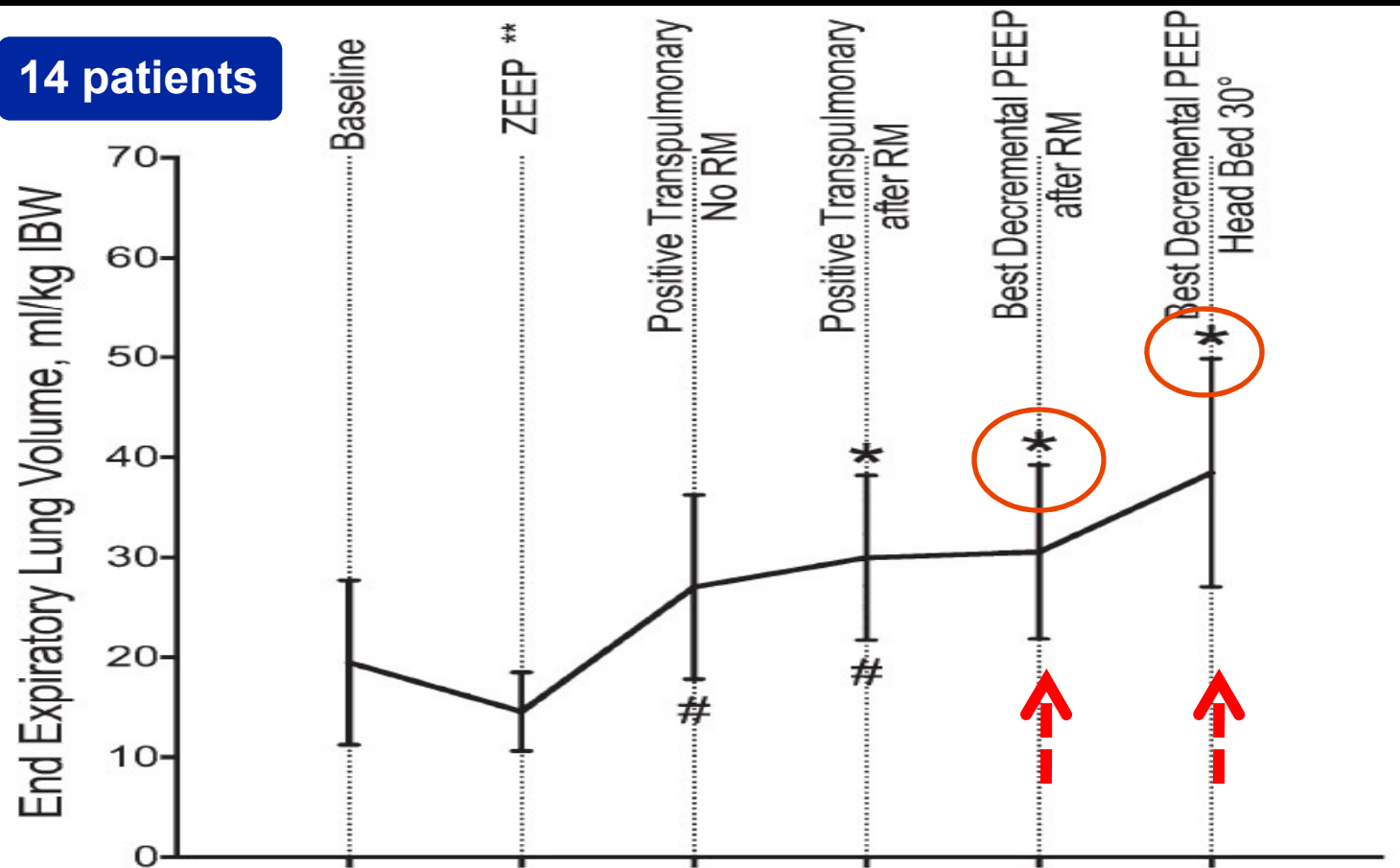
Massimiliano Pirrone, MD^{1,2}; Daniel Fisher, RRT³; Daniel Chipman, RRT³; David A. E. Imber, BA¹;
Javier Corona, MD^{1,4}; Cristina Mietto, MD^{1,2}; Robert M. Kacmarek, RRT, PhD^{1,3}; Lorenzo Berra, MD¹

- **Améliore les volumes pulmonaires**
- **Améliore l'élastance pulmonaire**
- **Améliore l'oxygénation**

Recruitment Maneuvers and Positive End-Expiratory Pressure Titration in Morbidly Obese ICU Patients

Massimiliano Pirrone, MD^{1,2}; Daniel Fisher, RRT³; Daniel Chipman, RRT³; David A. E. Imber, BA¹; Javier Corona, MD^{1,4}; Cristina Mietto, MD^{1,2}; Robert M. Kacmarek, RRT, PhD^{1,3}; Lorenzo Berra, MD¹

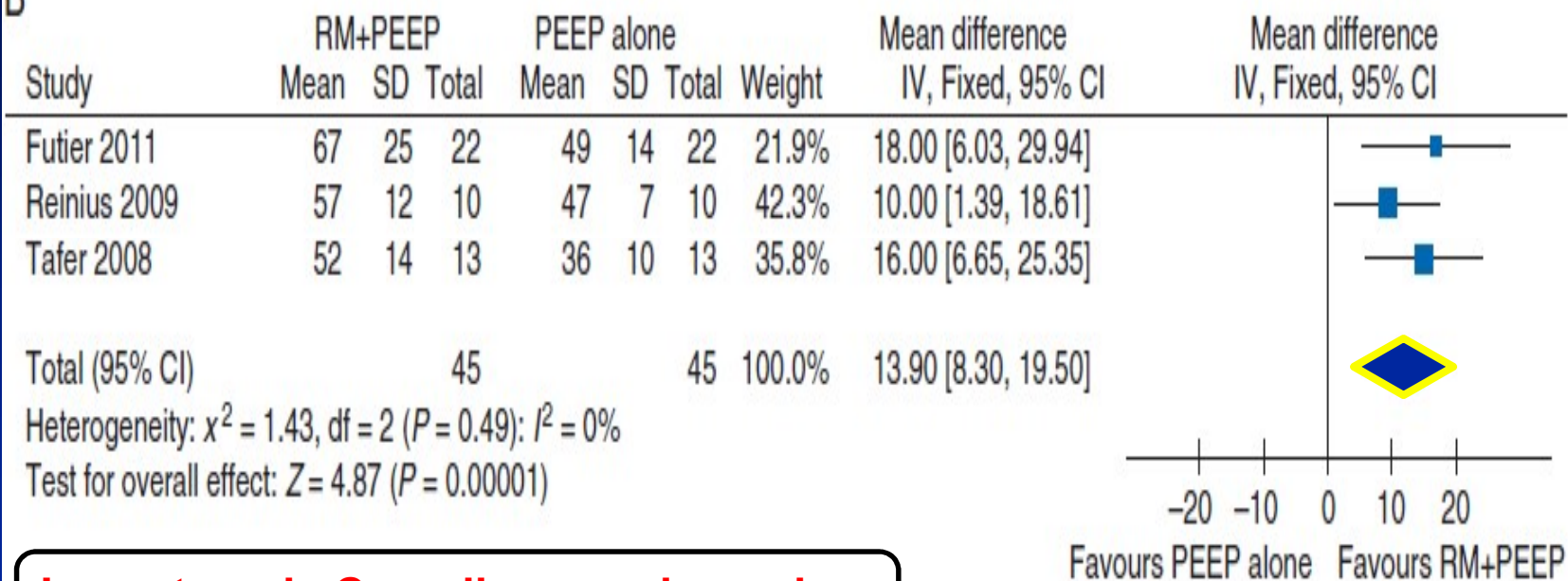
14 patients



REVIEW ARTICLES

Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis[†]

B

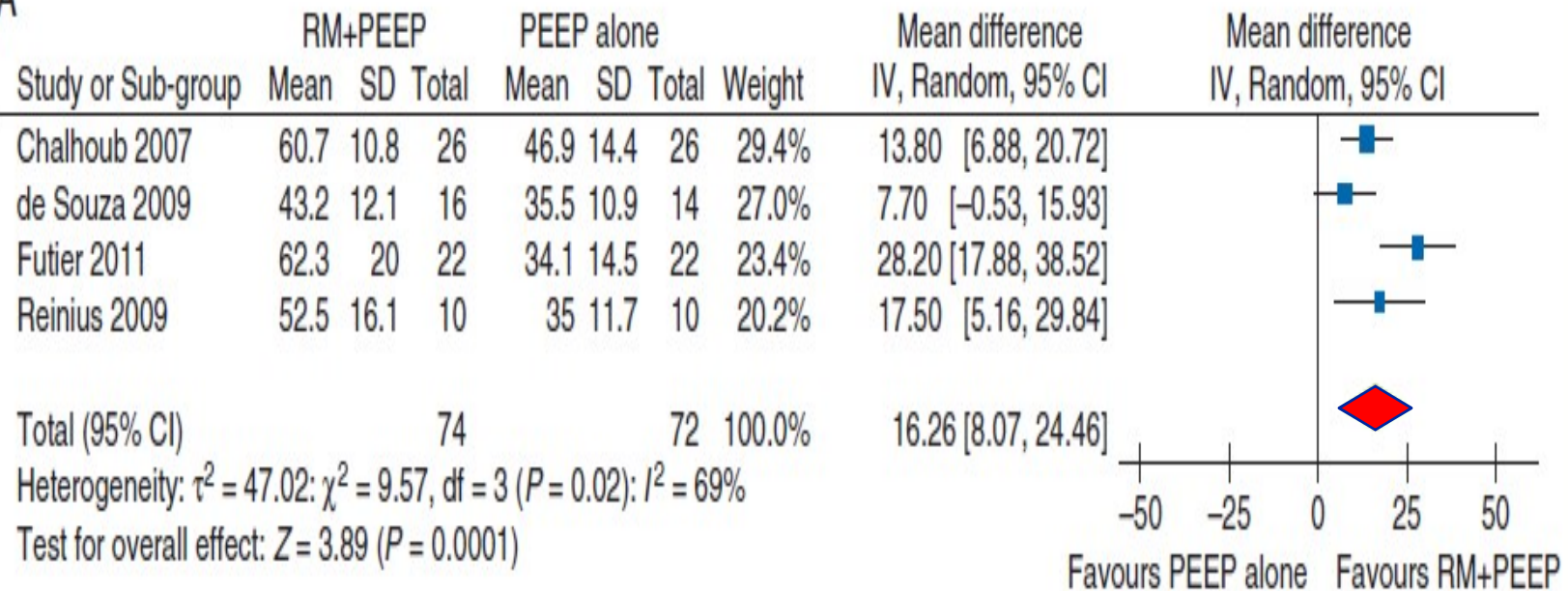


Impact sur la Compliance pulmonaire

REVIEW ARTICLES

Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis[†]

A



Impact sur PaO₂/FiO₂

British Journal of Anaesthesia **109** (4): 493–502 (2012)
 doi:10.1093/bja/aes338

Effets de la position

Obèse : 35 patients obèses¹/₂ assis (proclive 25-30°)



Figure 2. A morbidly obese patient placed in the sitting position during invasive mechanical ventilation in the ICU.

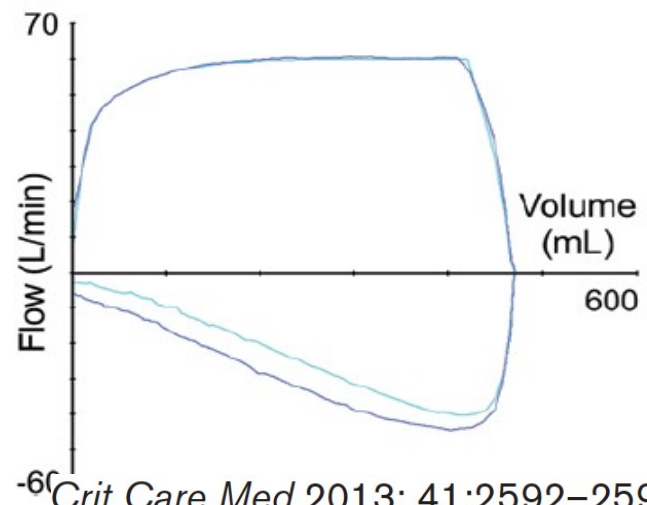
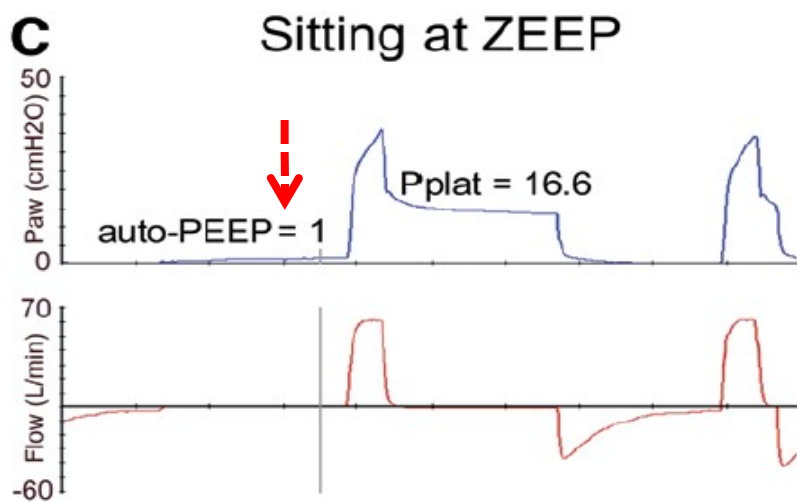
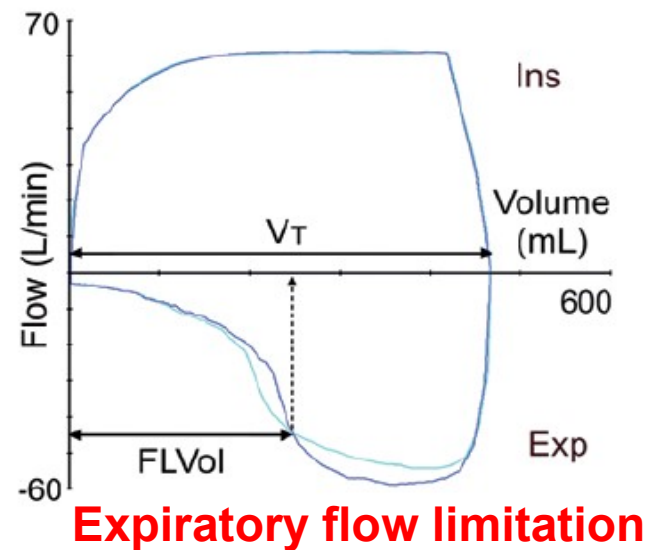
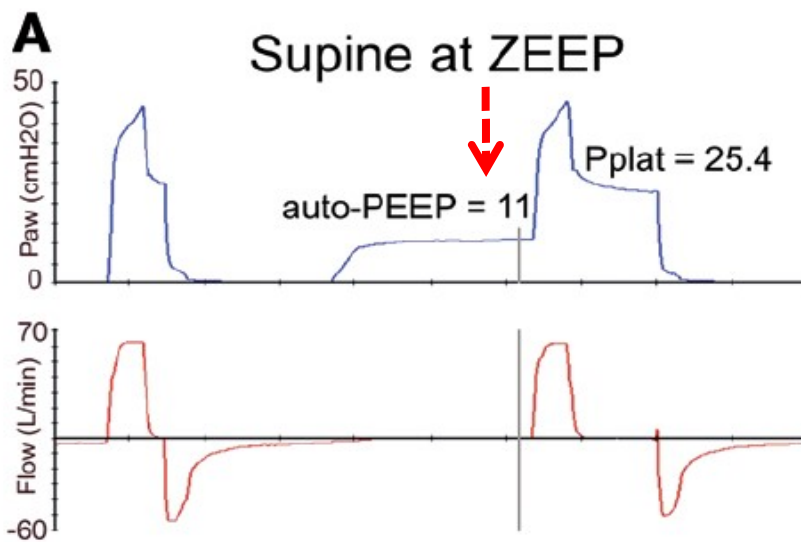
Crit Care Med 2013; 41:2592–2599

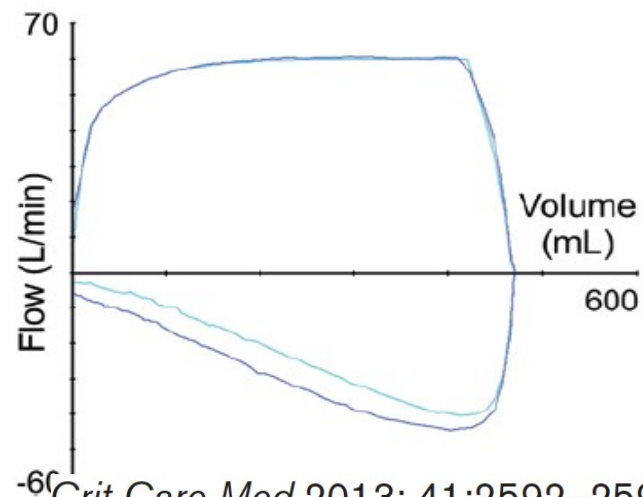
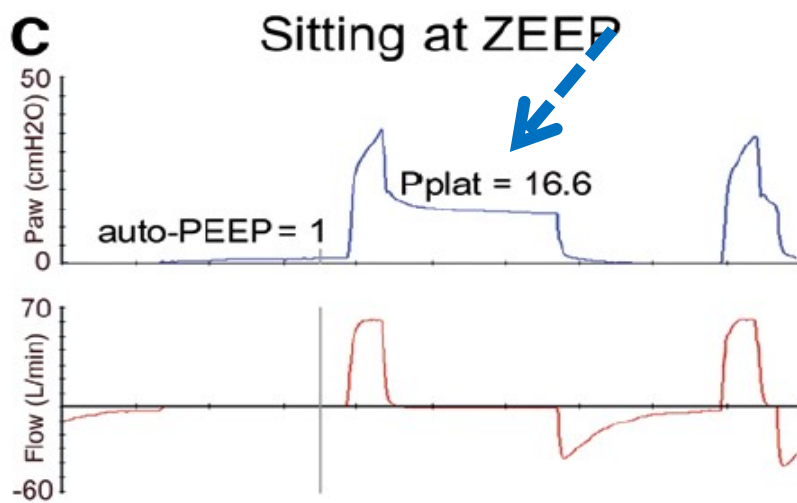
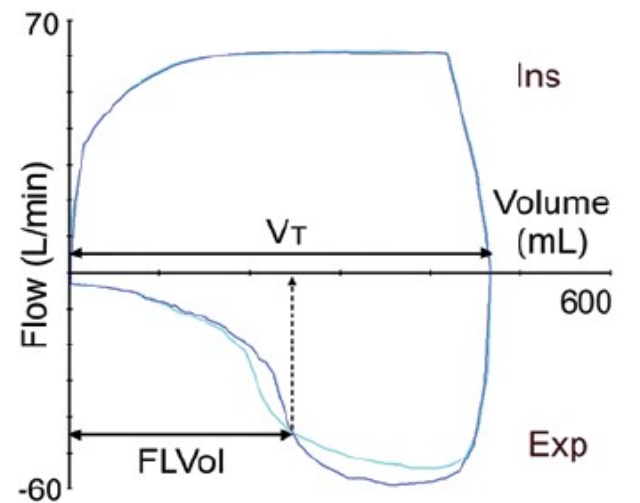
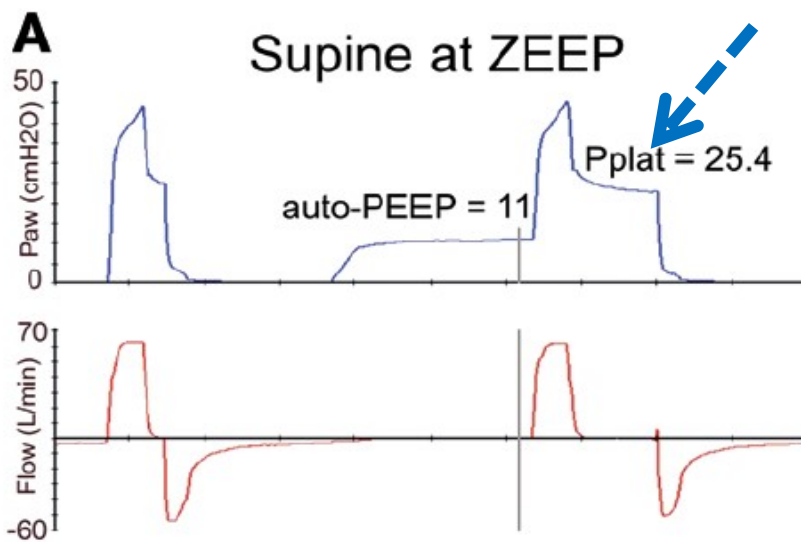
Effects of Sitting Position and Applied Positive End-Expiratory Pressure on Respiratory Mechanics of Critically Ill Obese Patients Receiving Mechanical Ventilation*

Crit Care Med 2013; 41:2592–2599

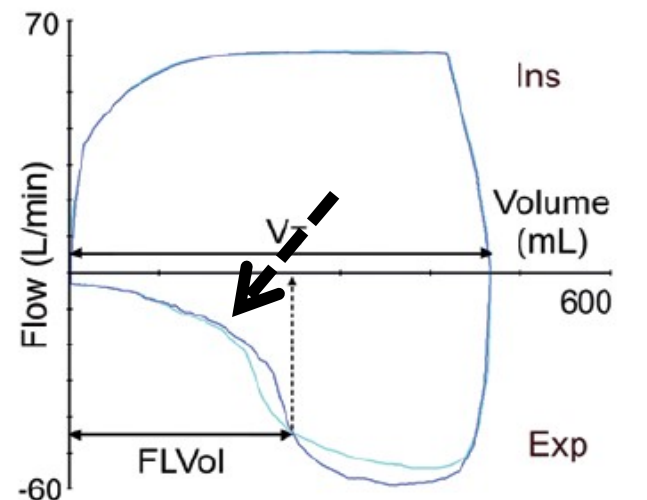
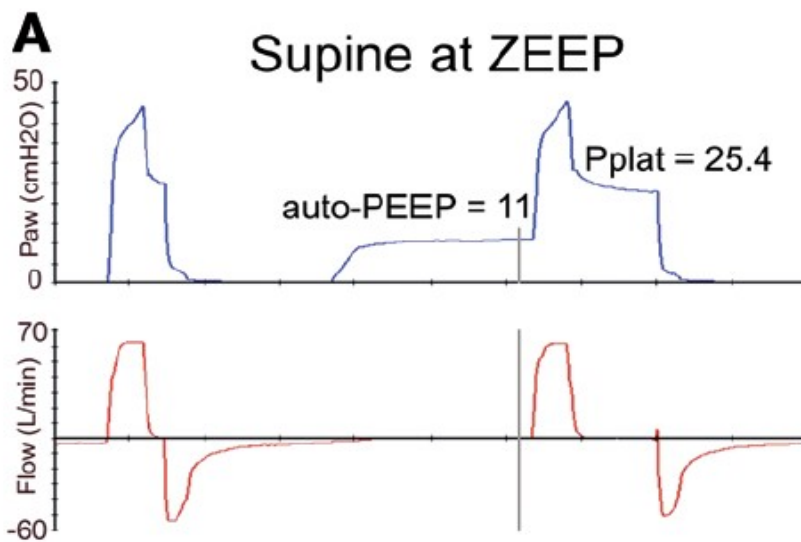
Bénéfices:

- Améliore la CV, La compliance pulmonaire
- Améliore la CRF (positionnement du diaphragme)
- Baisse de l'auto PEP
- Eviter le Reflux Gastro-oesophagien

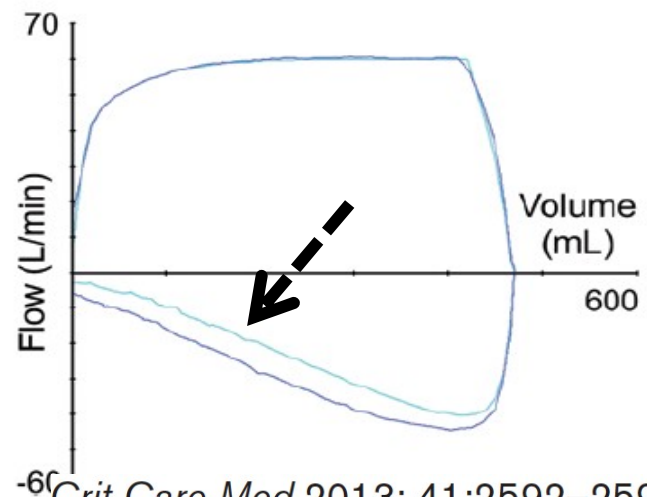
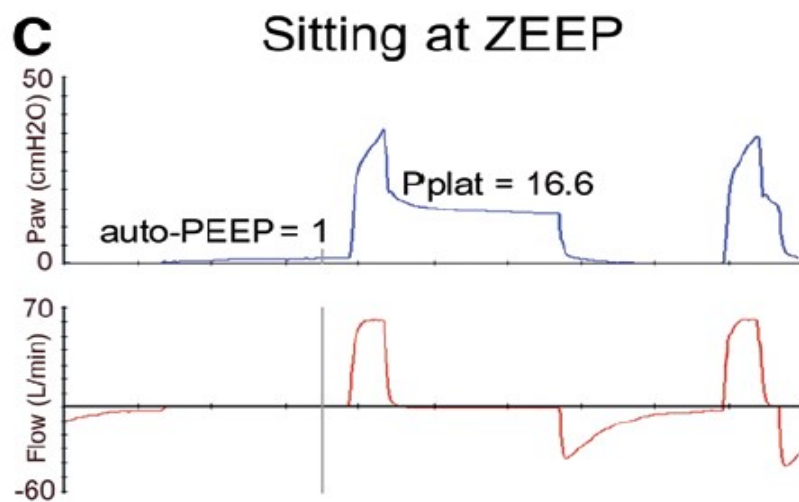




Crit Care Med 2013; 41:2592-2599



Expiratory flow limitation



Crit Care Med 2013; 41:2592-2599

Décubitus Ventral ???



CHEST

Original Research

CRITICAL CARE

Feasibility and Effectiveness of Prone Position in Morbidly Obese Patients With ARDS

A Case-Control Clinical Study

Audrey De Jong, MD; Nicolas Molinari, PhD; Mustapha Sebbane, MD; Albert Prades, Nursing Fellow; Emmanuel Futier, MD; Boris Jung, MD; G  rald Chanques, MD; and Samir Jaber, MD

CHEST 2013; 143(6):1554–1561

Feasibility and Effectiveness of Prone Position in Morbidly Obese Patients With ARDS



CHEST 2013; 143(6):1554–1561

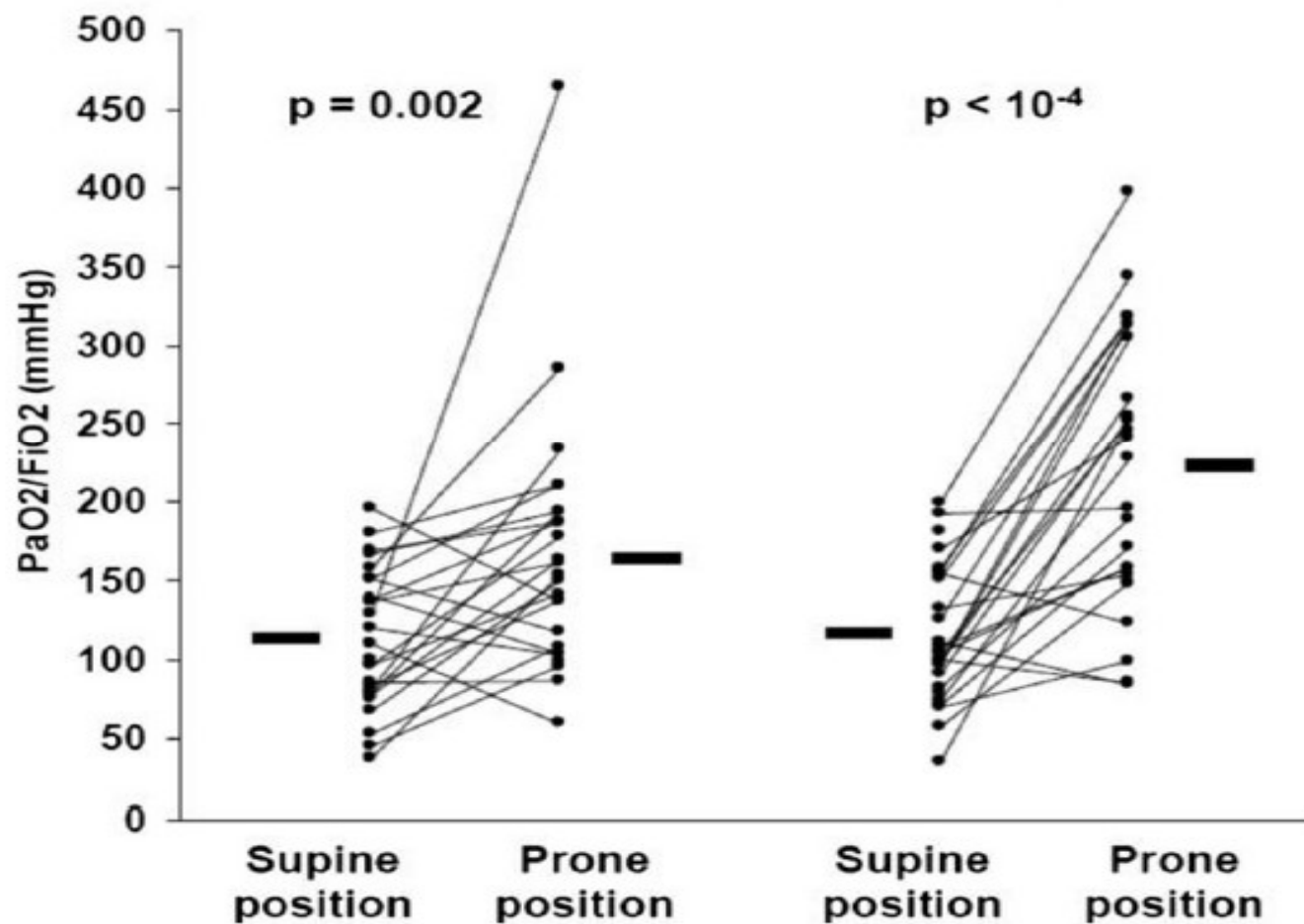


$\text{PaO}_2/\text{FiO}_2 < 200$

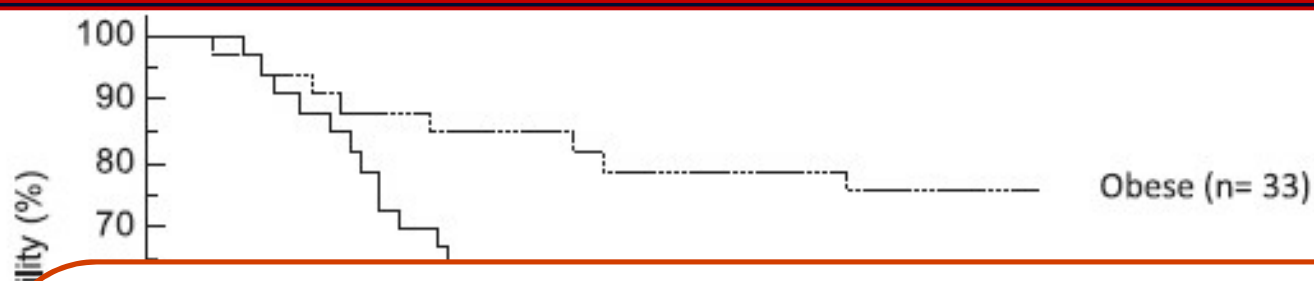
Non obese
(n=26)

Obese
(n=26)

$\text{BMI} > 35$



CHEST 2013; 143(6):1554-1561



Conclusion:

- * **PP** seems safe in obese patients and may improve oxygenation more than in nonobese patients.
- * **Obese patients could be a subgroup of patients with ARDS who may benefit the most of PP.**

FIGURE 4. The survival curve of obese vs nonobese patients. There was a significant difference in survival curves based on Kaplan-Meier analysis ($\chi^2 = 4.9601$; $P = .0259$).

Sevrage - Extubation

Mahul et al. *Critical Care* (2016) 20:346
DOI 10.1186/s13054-016-1457-4

Critical Care

RESEARCH

Open Access

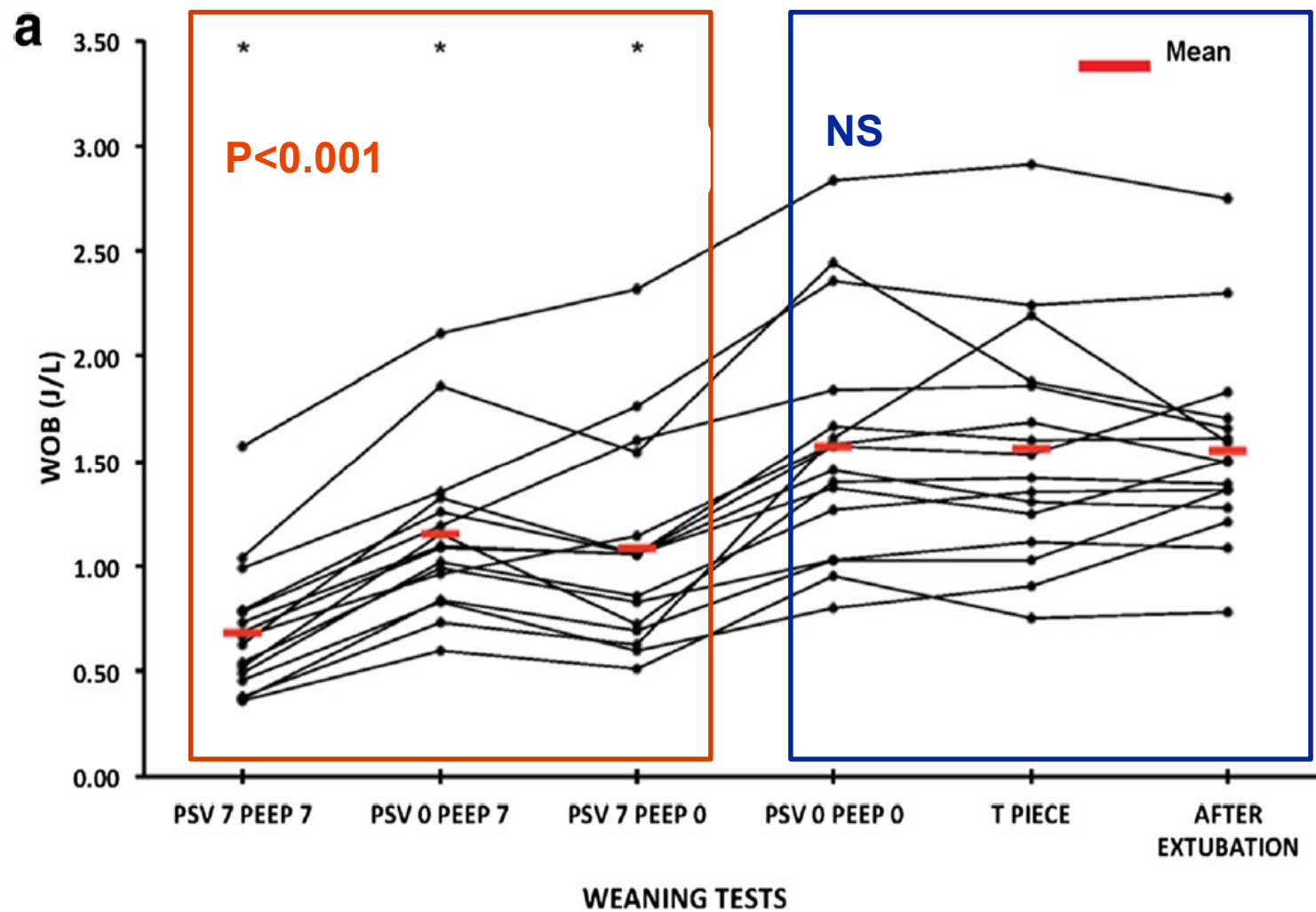


Spontaneous breathing trial and post-extubation work of breathing in morbidly obese critically ill patients

17 patients (BMI > 35)

Martin Mahul^{1†}, Boris Jung^{1,4†}, Fabrice Galia¹, Nicolas Molinari², Audrey de Jong¹, Yannaël Coisel^{1,4}, Rosanna Vaschetto³, Stefan Matecki⁴, Gérald Chanques^{1,4}, Laurent Brochard^{5,6} and Samir Jaber^{1,4*}

Mahul et al. *Critical Care* (2016) 20:346



Jean-Pierre Frat
Valérie Gissot
Stéphanie Ragot
Arnaud Desachy
Isabelle Runge
Christine Lebert
René Robert
for the Association des
Réanimateurs
du Centre-Ouest (ARCO)
study group

Impact of obesity in mechanically ventilated patients: a prospective study

Table 2 ICU course in obese and nonobese patients

Complication	Obese (<i>n</i> = 82)	Nonobese (<i>n</i> = 124)
Post-extubation stridor: no. (%)	10/65 (15.3%)	3/90 (3.3%)*

SD Standard deviation



Noninvasive ventilation for prevention of post-extubation respiratory failure in obese patients

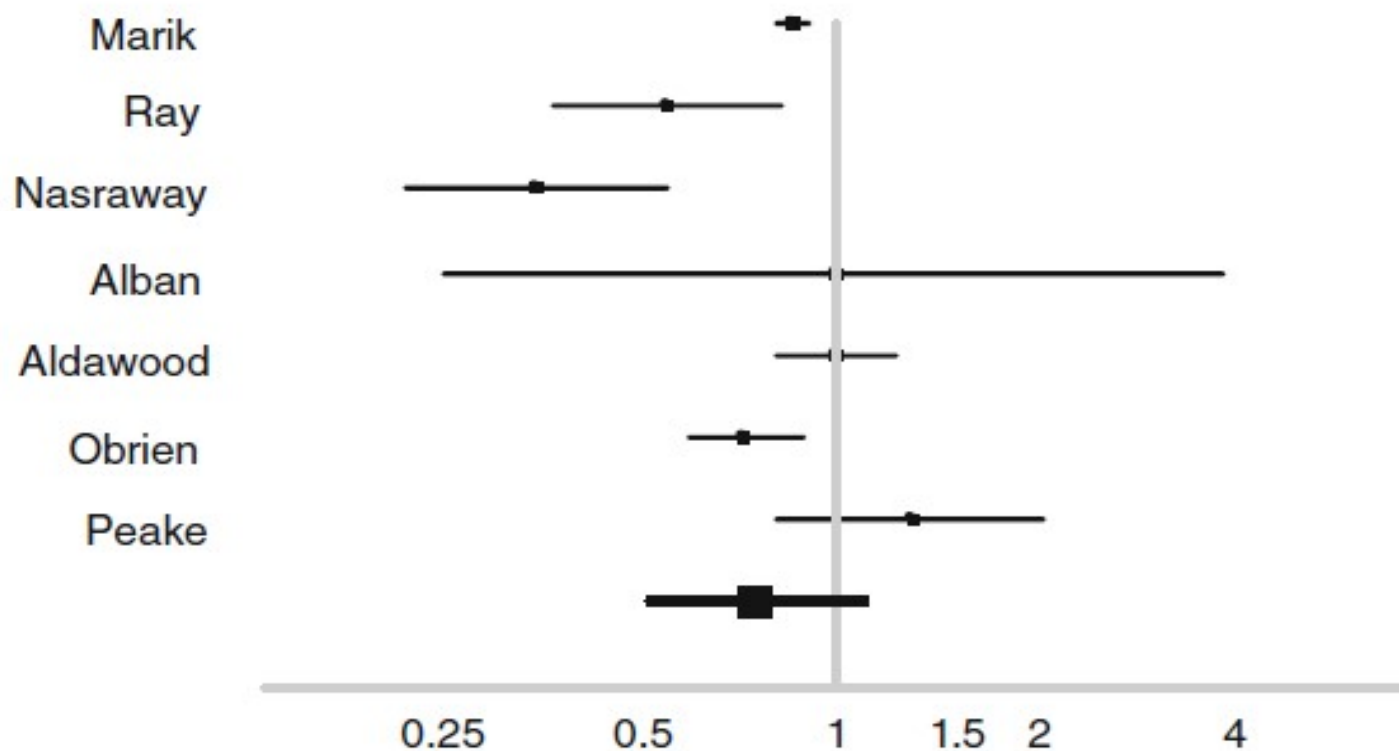
A.A. El Solh*, A. Aquilina*, L. Pineda*, V. Dhanvantri*, B. Grant*^{##} and P. Bouquin*

Paramètres	VNI (+) (62)	VNI (–) (62)	P
Détresse Respiratoire	6 (10%)	16 (26%)	0.03
Réintubation	6 (10%)	13 (21%)	0.14
Durée de Séjour Réa	11.8 ± 8	18 ± 11	<0.001
Durée de Séjour Hôpital	20.6 ± 11	26 ± 11	0.007
Mortalité	8 (13%)	15 (24%)	0.17

The impact of obesity on outcomes after critical illness: a meta-analysis

Obese vs. Normal

ICU Mortality



Influence of body mass index on outcome of the mechanically ventilated patients

Avril 2004, 349 réanimations, 4968 patients, 1008 patients obèses (20.2%)
dont 216 (4.3%) Obésité Morbide.

The Obesity Paradox!!!

Conclusion

Ventilation du Patient Obèse En Réanimation

- ❖ Patient obèse: Haut risque de Détresse Respiratoire et à l'hypoxémie
- ❖ Une Bonne Pré-oxygénation avant Intubation (VNI + **Position Proclive**)
- ❖ Intubation Difficile +++
- ❖ Volume courant: 6-8 ml/kg du poids idéal +++

Conclusion

Ventilation du Patient Obèse En Réanimation

- **Maintenir une pression de Plateau ≤ 30 cmH₂O**
- **FR: 15-21 cycles/min**
- **Utiliser une PEP de 8-10 Cm H₂O +++**
- **Manœuvres de recrutement +++**
- **Décubitus ventral si Hypoxémie Majeur**
- **VNI après Extubation**



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Merci